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Leveraging non-cognitive testing to predict success at USMC Scout Sniper Course

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THESIS

LEVERAGING NON-COGNITIVE TESTING TO PREDICT SUCCESS AT USMC SCOUT SNIPER COURSE

by

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March 2017

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We discover that significant relationships exist between military performance and graduation. Statistically significant predictor variables include rifle score, average proficiency and conduct marks, physical fitness score, the count of pull-ups on the USMC Initial Strength Test, and the Armed Services Vocational Battery subtests scores for Auto Shop and General Science. We also find the noncognitive traits of "grit," extroversion, conscientiousness, and neuroticism display statistical significance. We recommend the Marine Corps develop and standardize noncognitive measures to facilitate job matching, such as in the preselection of the most suitable scout sniper candidates.

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LEVERAGING NON-COGNITIVE TESTING TO PREDICT SUCCESS AT USMC SCOUT SNIPER COURSE

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LIST OF ACRONYMS AND ABBREVIATIONS

AFQT	Armed Forces Qualification Test
AI	auto information
AO	assembling objects
AR	arithmetic reasoning
AS	auto and shop information
ASR	Authorized Strength Report
ASVAB	Armed Services Vocational Aptitude Battery
BMI	Body Mass Index
CFT	Combat Fitness Test
CL	clerical
CMC	Commandant of the Marine Corps
DOD	Department of Defense
DOTMLPF	Doctrine, Organization, Training, Material, Leadership and education, Personnel, and Facilities
EI	electronic information
EL	electronics
FY	fiscal year
GS	general science
GT	general technical
HQMC	Headquarters Marine Corps
IST	Initial Strength Test
M&RA	Manpower and Reserve Affairs
MAGTF	Marine Air Ground Task Force
MC	Mechanical Comprehension
MCMAP	Marine Corps Martial Arts Program
MCO	Marine Corps Order
MCRC	Marine Corps Recruiting Command
MCRISS	Marine Corps Recruiting Information Support System
MEPS	Military Entrance Processing Station
MK	mechanical knowledge

MM	Mechanical Maintenance
MOS	Military Occupational Specialty
NAVMC	Navy Marine Corps
NJP	non-judicial punishment
OCCFLD	occupational field
OLS	Ordinary Least Squares
PC	paragraph comprehension
PFT	Physical Fitness Test
PII	Personally Identifiable Information
SI	shop information
TFDW	Total Forces Data Warehouse
TIP	Training Input Plan
USMC	United States Marine Corps
WK	word knowledge

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I. INTRODUCTION

Historically, about 55 percent of those enrolled at Scout Sniper Course fail the course. Each failure costs the Marine Corps time and money. Additionally, each drop from the course requires screening and preparing another Marine to attend a future course. Marines fail to complete the course for a variety of reasons. Some students who fail the course may not possess the physical, mental, or moral attributes required of a Marine Scout Sniper; others may be forced to remove themselves from training as the result of injuries. This thesis seeks to identify individual characteristics that best predict success at Scout Sniper Course.

A. BACKGROUND

1. Mission of Scout Sniper Course

The Marine Corps Training and Education Command website (2016) states the mission of Scout Sniper School is to, "Provide Marines and other services with Scout Sniper training in preparation for duty as a Scout Sniper within a Scout Sniper Platoon of an infantry battalion, reconnaissance unit and Marine Special Operations Unit" (U.S. Marine Corps, 2016, para. 1). Each year over 200 enlisted and select officers from infantry battalions, reconnaissance units, and special operations units from the Marine Corps and other services attend Scout Sniper Course. Students who meet the course prerequisites attend the course at either Weapons Training Battalion in Quantico, Virginia, or the School of Infantry locations aboard Camp Pendleton, California, or Camp Lejeune, North Carolina.

2. History of Scout Sniper Course

The United States military has long employed snipers on the battlefield. Peter Senich (1988), a military historian and weapons expert, submits, "The concept of employing special shoulder weapons for sniping at extreme ranges originated during the American Civil War" (p. 1). Major John Plaster, a retired U.S. Army sniper instructor, asserts in his book, *The History of Sniping and Sharpshooting*, that the Marine Corps

executed the first formal sniper course prior to entering World War I. Plaster (2008) reports, "The U.S. Marine Corps sniper course, set up at Quantico, Virginia, on 19 May 1918 was intensive and provided advanced training for selected men before they deployed to France" (p. 351). Plaster also notes, "According to an official USMC account, Quantico's Scout Snipers course graduated 75 noncommissioned officers and 375 privates who subsequently fought in Europe" (p. 352).

The conclusion of World War I also ended the Marine Corps Scout Sniper Course in Quantico. Unfortunately, the Marine Corps did little to develop sniper training or sniper weapons between World War I and World War II. As war in the Pacific began, the Marine Corps deployed with poorly trained and under-equipped snipers. Senich (1993) claims:

> While it seems that training and equipping scout-snipers may have been viewed as controversial, when compared to the almost insurmountable problems of organizing, training, and equipping entire combat divisions, as was then taking place, the efforts associated with fielding snipers was undoubtedly more of a nuisance. (p. 84)

As a result of poorly trained and equipped snipers at the beginning of World War II, the commander of the 1st Marine Division, Brigadier General Vandegrift, ordered a sniper school created on Guadalcanal. General Vandegrift witnessed the effectiveness of Japanese snipers and sought to counter their success with Marine snipers (Plaster, 2008, p. 482). The hastily created school trained two Marines from each rifle company on the island. Once the fighting on Guadalcanal concluded, the Marine Corps opened sniper schools at Camp Pendleton and Camp Lejeune. The five-week school at Camp Pendleton enrolled 15 students per course and focused largely on marksmanship. At Camp Lejeune, the course was three weeks long and with a capacity of 24 students per course. During the time it was active, the course at Camp Lejeune had a failure rate of over 40 percent (Plaster, 2008, p. 484). The Marine Corps dissolved both sniper schools at the conclusion of World War II.

In 1950, the 1st Provisional Marine Brigade prepared for deployment to Korea. The Marine Corps, "entered the Korean conflict with only a token number of sniping rifles" (Senich, 1993, p. 142). In addition, "a memorandum from Korea notes that sniper

rifles issued to a Marine Division are not employed as intended and in many cases, end up in the hands of officers and high ranking noncommissioned officers who have little or no opportunity to use the rifle gainfully as intended" (Plaster, 2008, p. 512). By 1952, regiments in the 1st Marine Division conducted sniper training in Korea. Plaster (2008) wrote, "Each company contributed six two-man teams for the three-week course, conducted just behind the front" (p. 519). When the Korean War came to end, the Marine Corps again discontinued sniper schools.

Twelve years after the Korean War ended, the Marine Corps deployed combat forces to Vietnam. Shortly after arriving in Vietnam, commanders realized the importance of snipers on the battlefield and sought to implement sniper schools. Plaster (2008) reveals, "Instead of the hodgepodge of battalion and regimental courses set up in the Korean War, which suffered from inconsistent instruction and often insufficient support, in Vietnam the Marine Corps operated division-level sniper schools" (p. 558). The 3rd Marine Division took the lead in sniper training in Vietnam and executed a four-week course. In November of 1966, the 1st Marine Division launched its first course in Vietnam. The course duration was just three days in order to get snipers to operational units as quickly as possible (Plaster, 2008, p. 562). The next year, the Marine Corps opened a four-week sniper school at Camp Pendleton as the result of the effectiveness of Marine snipers in Vietnam. Following the Vietnam War, the Marine Corps initially closed its sniper schools.

In 1977, the Marine Corps established a formal scout sniper course in Quantico based on the lessons learned in Vietnam (Battalion History, n.d., para. 3). Graduates from the course received the military occupational specialty (MOS) 8541-Marine Scout Sniper. The Marine Corps Training Publication 3–01E *Sniping* (2006) defines a Marine Scout Sniper as, "A Marine highly skilled in fieldcraft and marksmanship who delivers long range, precision fire at select targets from concealed positions" (p. 1–1). Plaster notes, "Graduates of the Quantico school soon began instructing at division-level Basic Sniper Training Courses at Camp Pendleton, California, and Camp Lejeune, North Carolina" (p. 591). The division schools have operated since the opening of the first formal school. In addition to the schools located at Camp Pendleton and Camp Lejeune, a schoolhouse

was opened in Kaneohe Bay, Hawaii, to train Marines in the 3rd Marine Division. However, in 2014, the 3rd Marine Division School closed. The Marine Corps currently operates three scout sniper schools. The schools at Camp Pendleton and Camp Lejeune both conduct three courses annually capable of enrolling 32 students. The school in Quantico conducts one Scout Sniper Course per year capable of training 32 students. Marines who successfully navigate the course earn the Necessary MOS 0317-Marine Scout Sniper. In 2006, the MOS was re-designated from 8541 to 0317.

3. Scout Sniper Course Prequalifications

In order for a Marine to attend Scout Sniper Course, the student must meet the course prerequisites outlined in each school's command screening checklist. The responsibility of screening and selecting Marines to attend the course resides with unit commanders. The course is open to Marines holding the rank of Lance Corporal through Gunnery Sergeant (E-3–E-7). Infantry officers and Ground Intelligence officers are eligible to attend the course; however, enlisted Marines serving in a Scout Sniper billet with 24 months of service after completing the course have priority. In addition to holding the appropriate grade, students must hold a MOS in the infantry occupational field. The infantry occupational field consists of Marines holding 03XX MOSs to include: Rifleman, Reconnaissance Marine, Light-armor Vehicle Marine, Machine Gunner, Mortarman, Infantry Assault Marine, Anti-Tank Missile Marine or Special Operations Marine.

Potential students must also possess a minimum general technical (GT) score of 100 on the Armed Services Vocational Aptitude Battery exam. The sum of an individual's arithmetic reasoning, word knowledge, paragraph comprehension, and mechanical comprehension subtest scores determine the GT score (Powers, 2016, p. 165).

Students enrolling in the course must also have a current 1st class Physical Fitness Test score (PFT). The Marine Corps PFT consists of dead-hang pull-ups, abdominal crunches, and a three-mile run. The maximum score for each event is 100 points with a maximum score of 300 points. An individual's score is an aggregate of each event score. According to Marine Corps Physical Fitness Program (2008), the minimum 1st class

score for males is 225 points (MCO 6100.13, 2008, p. 2–5). It is important to note the Marine Corps PFT scoring system changed effective 1 January 2017.

Enrollment criteria also include holding a current expert rifle score. The Marine Corps Combat Marksmanship Program (2014) states, "Qualification scores are based on an aggregate of Table 1 and Table 2 scores" (MCO 3574.2L, 2014, p. 6–7). Table 1 qualification consists of engaging targets at distances of 200, 300, and 500 yards. At the 200-yard distance, Marines engage targets from the sitting, kneeling and standing positions. At the 300-yard distance, Marines engage targets from the sitting and prone positions. The final stage of the qualification course requires a Marine to engage targets from a distance of 500 yards in the prone position. A potential student must score 220 out of 250 possible points on Table 1. Table 2 qualification requires Marines to engage targets at ranges 25 and 50 yards in the standing and kneeling positions. In addition, Marines are required to engage moving targets at the 100 and 200-yard distances in the kneeling position. The maximum score for Table 2 is 100 points. A Marine must have a minimum aggregate score of 305 to qualify as a rifle expert (MCO 3574.2L, 2014, p. 3–5).

In addition, students are required to have vision correctable to 20/20, and a student must not have been the subject of non-judicial punishment within the last six months.

4. Successful Completion of Scout Sniper Course

Graduation from Scout Sniper Course requires completion of the 12-week course with the minimum grade point average. The course is divided into three phases each four weeks in duration. Phase 1 includes a PFT, land navigation, known distance marksmanship and observation exercises. Phase 2 incorporates unknown distance marksmanship and individual movement techniques. Phase 3 involves mission planning and employment (Training Command, n.d.).

The initial phase starts with a PFT requiring that students score a minimum of 225 points to enroll in the course. The next evaluated event includes successful completion of day and night land navigation. The student must navigate to six of eight points in an

eight-hour period to satisfy the land navigation standard. This phase ends with known distance marksmanship qualification. To meet course standards, a student must score 28 out of 35 possible points during qualification. The M40A7 Sniper Rifle course of fire entails students engaging moving and stationary targets from the 300-yard distance and 500- through 1000-yard distances. Students fire five rounds at each distance. At distances of 300, 500, 600, 700, and 800 yards, students engage three stationary targets and two moving targets. At the 900- and 1000-yard distances students engage stationary targets only. In addition to qualifying with the M40A5, students must also qualify with the M110 Semi-Automatic Sniper System (SASS). The M110 qualification course of fire mirrors the M40A7 qualification; however, students do not engage targets from the 900- and 1000-yard distances (D. P. Mortensen, personal communication, September 27, 2016).

Phase 2 incorporates unknown distance marksmanship and individual movement techniques. During this phase, the students execute ten unknown-distance shoots. Qualification requires an 80 percent average after ten iterations. During each course of fire, ten targets are placed at varying distances between 300 and 800 yards. Students are awarded 10 points for a first round impact, eight points for a second-round impact, and zero points for failure to impact the target after two shots. In addition to unknown-distance marksmanship, students are evaluated on individual movement techniques, or stalking, during this phase. According to the approved Program of Instruction for the Scout Sniper Course (2015), "The student will execute 10 evaluated stalks. They must maintain a 70 percent average and have at least one (100)" (R. T. Sotelo, personal communication, September 27, 2016). Stalking requires a student to move undetected to a minimum prescribed range and engage an observer with blank ammunition from a Final Firing Position (FFP). Scores range from 40 to 100 points for each stalk. Failure to attain a perfect score stems from detection out of range, firing out of range, detection after engaging the observer, or detection during egress (R. T. Sotelo, personal communication, September 27, 2016).

Phase 3 involves mission planning and execution. This phase includes each student receiving an operations order, conducting mission analysis, and developing and briefing an operations order. Following the evaluation of the students' ability to

communicate their written order orally, they are assessed on execution of the briefed operations order. In addition, each student's evaluation during the culminating phase includes their ability to lead a team of up to six Marines.

B. THE PROBLEM

The shortage of properly trained Scout Snipers forces infantry battalions to deploy with degraded sniper capabilities. The Marine Requirements Oversight Council identifies the lack of formally trained Scout Snipers as insufficient for current and future operations. This scarcity of Scout Sniper Course graduates results in Scout Sniper platoons understaffed by nearly 60 percent. In June of 2016, 3rd Battalion, 6th Marine Regiment deployed with the 24th Marine Expeditionary Unit with two school trained snipers (Miller, 2016, Decision Brief). Unquestionably, a lack of school trained Scout Snipers deteriorates the effectiveness of infantry battalions. Figure 1 reveals the failure rate at 1st and 2nd Marine Division Scout Sniper Courses from FY12 through FY 16.

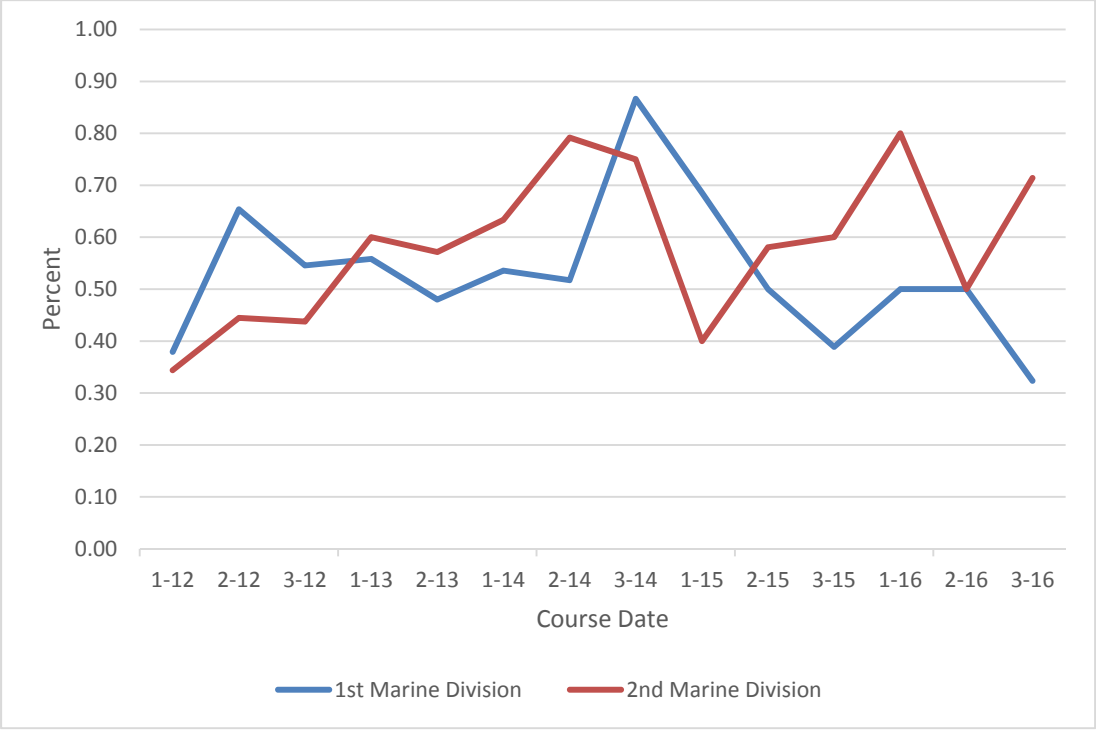

Figure 1. Scout Sniper Course Failure Rate by Course FY12–FY16

As a result of the elevated attrition rate, infantry battalions across the Marine Corps experience personnel shortfalls. Table 1 displays each battalion's deficiency of 0317 Scout Snipers.

Table 1. Current Scout Sniper Inventory for Lance Corporal-Sergeant. Source: Miller (2015).

Division Requirement	ASR	Onboard w/ AMOS	Onboard w/o AMOS	Total	Diff +/-	%Total to ASR	EAS Attrition FY16	Diff +/- ASR
1ST MARDIV	180	75	64	139	-41	77%	50	-91
1ST MARINES	60	32	24	56	-4	93%	15	-19
5th MARINES	60	23	28	51	-9	85%	18	-27
7th MARINES	60	20	12	32	-28	53%	17	-45
2ND MARDIV	135	60	37	97	-38	72%	42	-80
2ND MARINES	45	16	13	29	-16	64%	14	-30
6TH MARINES	45	29	11	40	-5	89%	19	-24
8TH MARINES	45	15	13	28	-17	62%	9	-26
3D MARDIV	45	21	4	25	-20	56%	13	-33
3D MARINES	45	21	4	25	-20	56%	13	-33
4th MARINES	0	0	0	0	0	0%	0	0
Total	360	156	105	261	-99	68%	105	-204

C. OBJECTIVES AND RESEARCH QUESTIONS

The primary objective of this study is to identify the demographic characteristics, performance attributes, and non-cognitive traits in a Marine that best predicts success at Scout Sniper Course. Completion of the 12-week course and receiving the 0317 MOS defines success. More concisely, this research seeks to answer the following questions:

1. What Scout Sniper Course pre-requisites ought to change as a result of this research?
2. What are the most influential independent variables that predict success at U.S. Marine Corps Scout Sniper Course?
3. What non-cognitive traits can be leveraged to predict success at Scout Sniper Course and performance as a Scout Sniper?

D. SCOPE AND LIMITATION

In an effort to reduce attrition at USMC Scout Sniper Course, we analyze student responses to a non-cognitive questionnaire, individual military performance, and

demographic traits to identify Marines with the greatest probability of completing the course. The sample population this research uses for analysis of observable traits is limited to students who attended Scout Sniper Course at 1st and 2nd Marine Division schools from FY12–FY16. The analysis of non-cognitive attributes is limited to one class at both 1st and 2nd Marine Divisions.

We construct econometric models to facilitate our quantitative statistical analysis. The economic models aid in determining which factors significantly contribute to success. Class rosters from each school enable the Total Forces Data Warehouse (TFDW) to provide the professional and personal information for the construction of our models. The outcomes of our models allow us to answer each research question.

E. ORGANIZATION OF THIS STUDY

Our research is organized into five chapters. Chapter I outlines the background and history of Scout sniper school, clarifies the purpose of this study, and introduces the research questions. Chapter II reviews literature that examines the relationship between cognitive and non-cognitive test results to predict success in the military. Chapter III details the compilation and cleaning of data from TFDW, and introduces the three econometric models we employ in our analysis. Chapter IV describes the results and analysis from our probit models. Chapter V reveals our conclusion and recommendations from this study.

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II. LITERATURE REVIEW

This chapter surveys research previously conducted regarding predictors of success for various military occupational fields. The benefits from each investigation examined are of particular value to manpower specialists. More specifically, the studies reviewed pertain directly to the relationship between ASVAB scores and job performance, or the connection between non-cognitive test results and success.

A. STUDIES ON THE RELATIONSHIP BETWEEN ASVAB AND JOB PERFORMANCE

Set motion in 1981, the joint-service Job Performance Measurement (JPM) project determines whether aptitude requirements translate to job performance. Mayberry (1990) determines the ASVAB a valid predictor of success for infantrymen. Mayberry's (1990) research focuses on the Marine Corps' infantry occupational field. During his study, he evaluates approximately 2,300 Marines from five different infantry MOSs. Each participant was tested over a two-day period on hands-on performance tests (HOPTs) and job knowledge tests (JKTs).

The Individual Training Standards (ITS) provided the framework for the HOPTs. Similar to the modern Infantry Training and Readiness Manual, Navy and Marine Corps Publication 3500.44, the ITS established training tasks, standards, and conditions for each event. The researchers select a sample of tasks and assigned weights to each task. Implementing the sampling method allows results from HOPTs to reflect an individual infantryman's ability to execute all infantry tasks based on their performance of the selected skills. In addition to the HOPTs, the researchers proctor JKTs in separate testing blocks that had between 190 and 200 total questions based on their MOS. The design of JKTs echo the skills required to successfully perform HOPTs. Additionally, Mayberry (1990) scrutinizes proficiency marks, training grades, rank, and time in service.

Mayberry's (1990) investigation reveals ASVAB scores a valid predictor of performance in the infantry. The results of Mayberry's (1990) research yield a strong connection between aptitude levels and performance on both HOPTs and JKTs.

Furthermore, Mayberry (1990) determines that the relationship between an individual's aptitude and performance extends into follow-on enlistments. In addition, Mayberry's (1990) findings indicate aptitude as critical to success as an infantry Marine.

Wathen (2014) furthers Mayberry's (1990) research by securitizing a single MOS. Wathen examines 1,100 Marines entering the 0621 Field Radio Operators MOS from FY2007 to 2014 to ascertain which pre-accession attributes contribute to success. In his thesis, He defines success as promotion to Corporal (E-4) and reenlistment eligibility based on the Computed Tier Score. Through his use of multivariate linear regression models, Wathen (2014) identifies several components of the ASVAB as influential to success to include: the general technical score, clerical score, general science score, and paragraph comprehension score. In addition, Wathen observes run time and crunches during the Initial Strength Test, rifle score, and the absence of a weight waiver prior to entering military service as statistically significant attributes contributing to success in the 0621 MOS. His findings provide tremendous insight into identifying and selecting recruits into a specific MOS; however, promotion to Corporal (E-4) requires several factors such as time in grade, time in service, rifle score, and physical fitness scores which are not available prior to entering the Marine Corps (Wathen, 2014).

The studies conducted by Mayberry (1990) and Wathen (2014) provide significant insight into the impact of ASVAB scores and job performance. This research analyzes variables that both researchers categorize as significant for success in a specific MOS. Moreover, Wathen's (2014) discovery of the initial strength test predicting success enables this study to further investigate pre-accession data to identify recruits with the greatest probability of success at Scout Sniper Course.

B. STUDIES ON THE RELATIONSHIP BETWEEN GRIT SCALE AND MILITARY SUCCESS

Many researchers have sought to identify the specific characteristics that enable individuals to thrive in the military; unfortunately, most research has focused only on tangible qualities that are overtly displayed. For example, many master's theses at the Naval Postgraduate School have scrutinized the value of recruits' physical fitness scores,

rifle scores, and performance evaluations to predict success, to include: McCaleb (2016), Griner (2016), Johnson (2015), Hinson (2005), Wong (2004), McNeill (2002), Snyder (1993), Schaffer (1996), Moreau (1992), Ray (1992), Yardley (1990), Carrier (1980), and Weinberg (1973). An article from the *Journal of Personality and Social Psychology* suggests that the military concentrates on the wrong qualities. The authors contend there is one essential personality trait that successful military leaders possess: "grit" (Duckworth, Peterson, Matthews, & Kelly, 2007, p. 1087).

Angela Duckworth, a professor at the University of Pennsylvania, created a self-reporting questionnaire named the Grit Scale. The Grit Scale seeks to determine an individual's desire to complete tasks over time. For example, one question asks, "I have overcome setbacks to conquer a challenge" (Duckworth et al., 2007, p. 1090). Responses on a point scale to each question range from "not at all like me" to "very much like me" (Duckworth et al., 2007, p. 1090). Duckworth et al. (2007) test their hypothesis, using six different cases: two online questionnaires, two studies of first-year cadets at West Point, a study of college students at the University of Pennsylvania, and a study involving competitors in a National Spelling Bee.

The research at West Point conducted by Duckworth et al. (2007) is of particular interest to this research. The purpose of the West Point study was to uncover what military decision makers believe to be the best predictor for success in the most challenging environments (Duckworth et.al., 2007, p. 1093). The intent of the initial summer training at West Point tests the physical and mental limits of new cadets. After successfully negotiating the rigorous enrollment process to attend West Point, approximately 1 in 20 cadets fails to complete the initial training (Duckworth et.al., 2007, p. 1094). The school previously relied on the Whole Candidate Score to predict cadet success. Duckworth reports, "The Whole Candidate Score is a weighted composite score of high school rank, SAT score; Leadership Potential Score, which reflects participation in extracurricular activities; and Physical Aptitude Exam" (p. 1095). Duckworth et al. (2007) sought to determine whether Grit Scale influenced cadets' ability to complete the demanding summer training. Within two or three days of arriving at West Point, 1,218 of 1,223, new cadets voluntarily completed the Grit Scale. The authors use separate binary

logistic regression analysis to contrast "grit," the Whole Candidate Score, and self-control to determine which instrument best predicts completion of summer training. Duckworth et al. (2007) report that Grit Scale results predicted completion of the summer training program better than any other predictors (p. 1095).

The U.S. Army has also implemented the Grit Scale to predict success during its 24-day Army Special Operations Forces (ARSOF) selection course (Winkler, Shulman, Beal & Duckworth, 2014, para. Study 1). In order to attend the ARSOF selection course, a soldier must first complete a 30-day preparation course. Despite successfully completing a month-long training course, nearly half of the candidates fail to complete the selection course. Winkler, Shulman, Beal, and Duckworth (2014) proctor the Grit Scale to four cohorts of individuals attending the selection course. After eliminating observations that withdrew from training for medical reasons and those with missing data, the final sample included 677 participants. Applying binomial logistic regression models, the researchers report "grittier" individuals were more likely to complete the selection course when controlling for physical fitness and intelligence. The researchers state the Army has typically used physical fitness and intelligence to predict course retention (Winkler et al., 2014, para. Study 1).

The authors acknowledge the limitations of their research and how future research can improve upon their findings. For example, the authors recognize the weaknesses of a self-reporting questionnaire and how the social desirability bias could impact on their results. Nevertheless, they provide recommendations to counteract that weakness by recommending future studies "develop an informant report, content analysis, and biodata measures of grit" (Duckworth et al., 2007, p. 1099). The researchers also address the potential problems of the homogenous population in both military studies. Individuals who self-select to attend West Point or the ARSOF selection course are more likely "grittier" than the typical soldier. Potentially, the short duration of the ARSOF selection course may not fully capture the effects of Grit Scale scores on completion.

Based on the reasons the authors provide to incorporate a Grit Scale and the evidence that each study yields, Duckworth et al. (2007) successfully make an argument for "grit" as a predictor of success. They strengthen their argument by providing

acknowledgment and response to potential shortcomings of their research. Moreover, the claim offered by Duckworth et al. (2007) could potentially alter the method military services use to evaluate and select new recruits. The Grit Scale as a predictor for military success presents another tool to measure quality and success for service members.

Each study conducted by Duckworth et al. (2007) concentrates on an individual's level of "grit" to predict success in a variety of settings. This research explores "grit" as an independent variable to determine graduation at Scout Sniper Course. Furthermore, this research seeks to gain insight into the correlation between "grit" and the different infantry MOSs and the correlation between "grit" and rank.

C. STUDIES IN BIG FIVE PERSONALITY TRAITS AND MILITARY JOB PERFORMANCE

Bartone, Eid, Johnsen, Laberg, and Snook (2009) analyze the effect of the Big Five personality traits to predict leader performance at the United States Military Academy West Point. Cadets arriving at West Point completed a self-reported 47-item questionnaire to determine their level of openness, conscientiousness, extroversion, agreeableness, and neuroticism. During their research, Bartone et al. (2009) performed multivariate regression analysis incorporating over 700 cadet observations. The authors found extroversion and conscientiousness significant predictors of leader performance. Extroversion best predicted leader performance while participating in summer training. During the summer training periods, students execute field training and unit challenges. However, during the academic year, conscientiousness displays importance as an explanatory variable to predict leadership. Bartone et al. (2009) also report neuroticism and agreeableness demonstrates some relationship with leadership performance; however, these traits were not significant in their regression analyses. Lastly, their research finds no correlation between openness and performance as a leader. Bartone et al. (2009) acknowledge the uniqueness of their population and recognize cadets are encouraged daily to develop as leaders by peers and superiors.

Black (2000) employs Big Five personality testing to predict job performance among 284 police recruits in New Zealand. Recruits completed the questionnaire at the

beginning of the 22-week training course. Black (2000) applies multivariate regression analysis incorporating openness, conscientiousness, extroversion, agreeableness, and neuroticism as independent variables. The dependent variables for this research include pre-entry cognitive test scores and final course grades. The regression analysis reveals cognitive test scores were strongly correlated with conscientiousness. Additionally, neuroticism was the only trait negatively associated with course performance. Openness and agreeableness were not significant with cognitive test scores or course performance. The author postulates personality traits and job performance are likely to vary based on job requirements. Furthermore, he asserts conscientious employees are valuable to every organization.

Studies seeking to leverage the Big Five personality traits to determine job performance are applicable to this study because of the established course prerequisites. The absence of variation in demographics and performance variables suggest successfully negotiating Scout Sniper Course stems from non-cognitive attributes. Therefore, this research endeavors to identify personality traits that naturally lend themselves to higher performance within the Scout Sniper community.

D. CHAPTER SUMMARY

Marine Corps infantry battalions endeavor to select to the most qualified Marines to attend Scout Sniper Course in order to achieve operational readiness. Entrance criteria for the course ensure the highest standards are met while satisfying the demands of operational units. Based on the literature reviewed, ASVAB scores and non-cognitive testing are appropriate metrics for predicting success and job performance. This research widens the aperture of previous research and seeks to leverage non-cognitive testing.

III. DATA AND METHODOLOGY

This chapter describes the different organizations that contributed data, the variables used in each model, and the methodology for statistical examination. All data covers the period from FY12–FY16.

A. THE DATA

This research seeks to determine which observable characteristics and performance qualities best predict success at Scout Sniper Course. In addition, this study attempts to identify non-cognitive traits associated with course completion. The subsequent section details the data sources and following analysis.

1. Total Force Data Warehouse

We confine our analysis to Marines who attend Scout Sniper Course at 1st or 2nd Marine Division from FY12 through FY16. We procure the data for this research from Manpower and Reserve Affairs (M&RA) via the Total Force Data Warehouse (TFDW). According to the M&RA (n.d.) website:

> The Total Force Data Warehouse (TFDW) is the Marine Corps official system of record for USC Title 10 end strength reporting and houses more than 30 years of historical manpower data from a variety of USMC and DOD systems in one central location to provide manpower analysts. (Manpower & Reserve Affairs, n.d., para. 3)

Data acquired from TFDW produces a snapshot of a Marine's career at a specific time. The information available from this database includes: ASVAB scores, education level, demographics, fitness scores, and marksmanship scores. Depending on the field, the data updates monthly or when it changes (Wathen, 2014, p. 13).

Class rosters from both division schools provide the data we use for this investigation. In order to capture the individuals' characteristics at the time they attend the course, we create 15 separate files based on the month and year of the course convene date. TFDW removes all personally identifiable information and substitutes a unique identifier for each individual prior to returning the file.

2. Noncognitive Data

One class at each division's schoolhouse provides the data for the non-cognitive analysis. Each course administered a pencil and paper questionnaire to all students during the first week of training. The form used for this research consists of Angela Duckworth's Grit Scale and a Big Five Inventory questionnaire from the Fetzer Institute. A 5-point Likert scale evaluates responses, where 1=disagree strongly and 5=agree strongly (Duckworth, et al. 2007, p. 1093). The questionnaire seeks to determine each student's level of "grit," openness, conscientiousness, extroversion, agreeableness, and neuroticism. To determine if non-cognitive traits predict success when holding constant Scout Sniper Course prerequisites, we examine the inputs from the questionnaire. Appendix contains the Grit Scale adapted from Duckworth, and Appendix B covers the Big Five Questionnaire adapted from the Fetzer Institute.

The observations include Marines from each infantry MOS and range in rank from Lance Corporal to Staff Sergeant. In addition, Marines from reconnaissance units and Marine Corps Special Operations Battalions participate in the study. The 1st Marine Division Scout Sniper School distributed the questionnaire to 32 students. However, two students exercised their right to opt out of the study. The following month, students attending the course at the 2nd Marine Division's school completed the questionnaire. All eighteen students attending the course participated in the study. We convert the inputs to a Microsoft Excel workbook for analysis once all 50 forms return via certified mail.

3. Sample Restriction and Number of Observations

In order to conduct a proper analysis, we remove observations with missing or incomplete information. Each year members of Navy SEAL teams and U.S. Army Special Forces attend the USMC Scout Sniper Course. Consequentially, we remove those students from the analysis because TFDW does not house their information (n=14). In addition, incorrectly entered names or Electronic Data Interchange Person Identifier (EDIPI) on class rosters prevents locating those observations in TFDW (n=18). Next, we remove observations with missing data fields for independent variables (n=82). After cleaning the data and constraining analysis to the accurate number of students, we

examine the remaining 742 observations. Table 2 reflects the number of students that attended the course each year and the number of observations removed.

Table 2. Summary of Marines Attending Scout Sniper Course at 1st and2nd Marine Division FY12–FY16

FY	Observations in Original Sample	Observations Removed	Observations used in study
FY2012	179	35	144
FY2013	135	24	111
FY2014	161	22	139
FY2015	183	12	171
FY2016	198	21	177

4. Assumptions and Limitations of the Data

Our research assumes students did not succumb to the social desirability bias when completing the self-reporting questionnaire. Fisher (1993) defines social desirability bias as the, "systematic error in self-report measures resulting from the desire of respondents to avoid embarrassment and project a favorable image to others" (p. 303). Fisher (1993) also reports, "Prior studies have found that social desirability bias can attenuate, inflate, or moderate variable relationships; increase measurement error; and affect means" (p. 304). Several of the questions asked on the questionnaire signal characteristics one might expect to find in a Scout Sniper. Such questions included: "Is a reliable worker," "Is relaxed and handles stress well," "I am a hard worker," or "Setbacks don't discourage me" (Duckworth, et al., 2007, p. 1090). To combat the social desirability bias, the questionnaire proctors ensure participants' responses are confidential and no adverse consequences would come from the results of their answers. This research assumes that all students answered each question honestly.

B. VARIABLE DESCRIPTIONS

This section describes the variables provided by TFDW and the non-cognitive questionnaire inputs examined for inclusion in this investigation.

1. Dependent Variable

The dependent variable in this study is "GRAD," and classified as binary variable indicating whether a student graduated Scout Sniper Course. A "1" indicates success and a "0" indicates failure. Table 3 displays the summary statistics for the dependent variable. The mean depicts the percentage of students with a value of 1 for that variable.

Table 3. Summary Statistics for Dependent Variable

Dependent Variable	Obs	Mean	Std.Dev.	Min	Max
GRAD	742	0.46	0.49	0.0	1.0

2. Independent Variables

The independent variables used in this study are divided into one of five categories: demographics, ASVAB scores, performance, and non-cognitive traits. The following sections provide a more detailed description of each independent variable.

a. Demographics

The majority of demographic variables do not require further explanation. This section contains both continuous and binary variables. The binary variables include home of record, race, education, marital status, MOS, and rank. We divide the polychotomous nominal variable race into two categories as the result of limited diversity in the data. Transforming the categorical variable home of record into a binary variable using Marine Corps Recruiting Districts (Appendix C adapted from MCRC) allows us to determine if observations from specific regions have a greater probability of graduating the course. In addition, we convert the categorical variables rank and MOS to dummy variables. The

continuous variables consist of age and years of service. Table 4 provides the summary statistics for the demographic variables.

Table 4. Demographic Summary Statistics

Variable	Frequency	Mean	Std. Dev.	Min	Max
Age	742	23.0	2.721	18.0	38.0
White	691	0.93	0.000	0.0	1.0
Non-White	51	0.07	0.000	0.0	1.0
Married	238	0.32	0.000	0.0	1.0
Years of Service	742	3.2	2.261	0.0	20.0
District 1	115	0.15	0.000	0.0	1.0
District 4	90	0.12	0.000	0.0	1.0
District 6	98	0.13	0.000	0.0	1.0
District 8	116	0.16	0.000	0.0	1.0
District 9	149	0.20	0.000	0.0	1.0
District 12	172	0.23	0.000	0.0	1.0
Private First Class	3	0.01	0.000	0.0	1.0
Lance Corporal	298	0.40	0.000	0.0	1.0
Corporal	293	0.39	0.000	0.0	1.0
Sergeant	127	0.17	0.000	0.0	1.0
Staff NCO	21	0.03	0.000	0.0	1.0
Rifleman	334	0.45	0.000	0.0	1.0
Recon Marine	138	0.19	0.000	0.0	1.0
Machine Gunner	101	0.14	0.000	0.0	1.0
Mortarman	54	0.07	0.000	0.0	1.0
Assault Marine	41	0.06	0.000	0.0	1.0
Anti-Tank Missile Marine	28	0.04	0.000	0.0	1.0
Infantry Unit Leader	7	0.01	0.000	0.0	1.0
Critical Skills Op	39	0.05	0.000	0.0	1.0

b. ASVAB Scores

According to the Official Site of the ASVAB (n.d.), "The ASVAB is a multiple-aptitude battery that measures developed abilities and helps predict future and occupational success in the military" (ASVAB, para. 1). Furthermore, the website provides detailed descriptions of the subtests and are provided in Table 5. Each subtest is scored independently. This research incorporates those scores as continuous variables. The summary statistics for each subtest are outlined in Table 6.

Table 5. ASVAB Subtest. Adapted from Wathen (2014).

Test	Description
General Science (GS)	Knowledge of physical and biological sciences
Arithmetic Reasoning (AR)	Ability to solve arithmetic word problems
Word Knowledge (WK)	Ability to select the correct meaning of a word presented in context and to identify best synonym for a given word
Paragraph Comprehension (PC)	Ability to obtain information from written passages
Mathematics Knowledge (MK)	Knowledge of high school mathematics principles
Electronic Information (EI)	Knowledge of high school mathematics principles
Auto Shop Information (AS)	Knowledge of automobile technology, shop terminology and practices
Mechanical Comprehension (MC)	Knowledge of mechanical and physical principles

Table 6. ASVAB Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
AFQT	742	72.0	15.0400	33.0	99.0
GS	742	55.9	6.689	0.0	77.0
AR	742	56.8	6.638	0.0	72.0
WK	742	53.7	6.224	0.0	74.0
PC	742	55.6	6.696	0.0	69.0
MK	742	57.0	6.478	0.0	72.0
EI	742	55.0	7.726	0.0	74.0
AS	742	52.8	7.408	0.0	78.0
MC	742	58.4	7.318	0.0	78.0

c. Performance

Performance variables in this study include proficiency and conduct marks, fitness scores, and marksmanship scores. In addition, we incorporate Initial Strength Test (IST) scores as a pre-accession performance trait. All performance variables are continuous and Table 7 provides the summary statistics.

The Marine Corps fitness tests and marksmanship program have been previously discussed in Chapter I. However, a Marine's proficiency and conduct marks and Initial Strength Test require further explanation. Proficiency (PROs) and Conduct (CONs) marks serve as the metric when evaluating Marines holding the ranks of Private through Corporal. A point scale from 0=Unacceptable to 5=Outstanding delineate performance for both PROs and CONs. According to the Marine Corps Individual Records Administration Manual (2008), conduct includes, "In addition to observance of the letter of law and regulations, conduct includes conformance to accepted usage and custom, and positive contributions to unit and Corps" (p. 4–39). Proficiency marks, "should indicate

how well a Marine performed the primary duty during the marking period" (IRAM, 2008, p. 4–42). The Initial Strength Test, a modified PFT, requires a recruit to perform pull-ups, abdominal crunches, and a 1.5-mile run. In order to begin recruit training, applicants must perform a minimum of two pull-ups, 44 crunches, and complete the run in 13 minutes (Initial Strength Test, para 1).

Table 7. Performance Variable Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Proficiency Marks	742	44.1	0.978	40.0	48.0
Conduct Marks	742	44.1	1.041	40.0	48.0
PFT Score	742	281.8	13.304	216.0	300.0
CFT Score	742	297.2	4.949	264.0	300.0
Rifle Score	742	50.6	15.038	1.0	81.0
Rifle Expert	742	0.79	0.408	0.0	1.0
Rifle Sharpshooter	742	0.19	0.391	0.0	1.0
Rifle Marksman	742	0.02	.0.141	0.0	1.0
IST Crunches	742	92.4	22.372	12.0	190.0
IST Minutes	742	9.8	1.325	0.0	22.0
IST Pull-ups	742	15.1	5.339	2.0	33.0

Proficiency and Conduct marks multiplied by 10 for uniformity.

d. Non-cognitive Traits

Prior to assuming his current role as Chairman, Joint Chiefs of Staff, General Joseph Dunford served as the 36th commandant of the Marine Corps. In his planning guidance, he states:

> We will quickly assess the efficacy of available psychological screening tools currently used by special operations forces, law enforcement organizations, and industry. We will subsequently use the best available tools to better predict the resiliency of recruits and their probability of successfully completing an enlistment. (2015, p. 6)

Following General Dunford's guidance, we incorporate create six continuous variables to measure non-cognitive traits. These variables include: "grit," openness, conscientiousness, extraversion, agreeableness, and neuroticism. These control variables originate from student inputs on a self-reporting questionnaire.

We postulate serving as a Scout Sniper requires higher levels of "grit." In order to attend the school, perspective students participate in a rigorous screening process testing their physical toughness and mental agility. Successful completion of the screening process entails months of preparation. Once an individual passes selection, they endure the arduous three-month course in order to become a Scout Sniper. The determination required to accomplish this long-term goal epitomizes "grit."

The U.S. Air Force conducted studies incorporating Big Five elements and determine that, "The need and development of personality measures to enhance person-job-match and increase retention" (Weissmuller & Schwartz, 2006, p. 1.). We integrate Big Five personality traits in an effort to identify attributes leading to successful job performance as a Scout Sniper. As previous studies found, we anticipate a positive relationship between conscientiousness and "grit." The traits associated with conscientiousness appear ideal for an individual serving in an occupational field requiring meticulous planning and attention to detail. The trait neuroticism closely translates to emotional stability; therefore, we expect lower student scores. Individuals with excessive neuroticism scores likely lack the levelheadedness to serve as a Scout Sniper. In addition, the traits affiliated with extraversion do not appear commensurate with the attributes found in Scout Snipers. The nature of Scout Sniper missions necessitates the ability to operate in small teams. Elevated individual levels of assertiveness potentially degrade teamwork. The description of the trait openness entails curiosity and imagination. Therefore, we suspect openness applies to Marines serving in a 0317 billet because sniper employment often requires creativity to remain undetected. Similar to Black's (2009) research with police officers, we do not believe agreeableness applies to performance as a Sniper. Individuals performing their duties as a sniper cannot afford tendermindedness to hinder mission accomplishment. Table 8 summarizes each of the non-cognitive variables we include in our study.

Table 8. Non-cognitive Variable Descriptions.
Adapted from John and Srivastava (1999).

Variable	Description
Grit	Courage Conscientiousness Endurance Long-Term Goals Resilience
Extraversion	Gregariousness (sociable) Assertiveness (forceful) Activity (energetic) Excitement-seeking (adventurous) Positive emotions (enthusiastic) Warmth (outgoing)
Agreeableness	Trust (forgiving) Straightforwardness (not demanding) Altruism (warm) Compliance (not stubborn) Modesty (not show-off) Tender-mindedness (sympathetic)
Conscientiousness	Competence (efficient) Order (organized) Dutifulness (not careless) Achievement striving (thorough) Self-discipline (not lazy) Deliberation (not impulsive)
Neuroticism	Anxiety (tense) Angry hostility (irritable) Depression (not contented) Self-consciousness (shy) Impulsiveness (moody) Vulnerability (not self-confident)
Openness	Ideas (curious) Fantasy (imaginative) Aesthetics (artistic) Actions (wide interests) Feelings (excitable) Values (unconventional)

Table 9 details the summary statistics for each non-cognitive variable to include: the number of observations, mean, standard deviation, minimum value, and maximum value.

Table 9. Summary Statistics for Non-cognitive Analysis.

Variable	Obs	Mean	Std. Dev.	Min	Max
Grit	48	4.1	0.340	3.0	4.75
Extraversion	48	27.2	5.375	15.0	39.0
Agreeableness	48	35.1	4.968	24.0	45.0
Conscientiousness	48	38.3	5.072	25.0	45.0
Neuroticism	48	17.5	5.319	9.0	28.0
Openness	48	36.3	5.417	26.0	48.0

C. METHODOLOGY

Wooldridge (2016) defines multiple linear regression as, "a model linear in its parameters, where the dependent variable is a function of independent variables plus an error term" (p. 784). We leverage probit modeling to capture the probability of success in our binary response variable GRAD. Wooldridge (2016) also submits a probit model is, "A model for binary responses where the response probability is the standard normal cumulative density function evaluated at the linear function of the explanatory variables" (p. 766). Unlike the Linear Probability Model, the probit model confines the response probability between one and zero.

$$P = (y = 1 \mid x) = G(\beta_0 + x\beta)$$

In the above model, P equates to the response probability, y represents the result, x denotes predictor variables, G represents the cumulative density function, coefficient estimates are denoted by β, and x is a control variable (Wooldridge, 2016, p. 525).

We exercise stepwise regressions to select the variables included in each model. Draper and Smith (2014) report, "The stepwise regression procedure starts off by choosing an equation containing the single best X variable and then attempts to build up with subsequent additions of X's one at a time as long as these additions are worthwhile" (p. 335). For our stepwise selection procedures, we select a p-value threshold of .25 rather than the traditional .05 in order to select the best possible model (Kirkwood & Sterne, 2010, p. 341).

Holding all else constant, the partial effect for a binary variable is the percent change in the response probability. For continuous variables, to calculate the partial effects requires calculating the derivative for that variable (Johnson, 2015, p. 32).

D. ECONOMETRIC MODELS

1. Model 1

$$P(GRAD_i = 1) = G(\beta_0 + \beta_1 rifle\_\exp_i + \beta_2 first\_pft_i + \beta_3 GT\_hundred_i)$$

The probit model above, Model 1, contains the full sample population of 742 observations. We use this model to analyze the extent to which current attendance criteria to determine if course prerequisites relate to graduation. The predictor variables considered in this model include rifle expert, first class PFT, and a GT score of at least 100.

2. Model 2

$$P(GRAD_i = 1) = G(\beta_0 + \beta_1 dems_i + \beta_2 performance_i + \beta_3 asvab\_scores_i)$$

Model 2 employs probit modeling to estimate what observable attributes are most correlated with graduation. This model includes the entire sample population. The reference group for this model possesses the following characteristics: rank other than NCO, rifleman, older than 25, high school graduate, two tofour years of service, single, white, rifle expert, pistol sharpshooter, PFT score higher than 285, and average proficiency and conduct marks (4.4).

3. Model 3

$$P(GRAD_i = 1) = G(\beta_0 + \beta_1 dems_i + \beta_2 noncog_i)$$

This probit model leverages non-cognitive traits to predict the probability of graduation holding constant course prerequisites. This model contains all 48 observations from the surveys.

E. CHAPTER SUMMARY

This chapter details the data and methodology used in this investigation. In order to perform worthwhile analysis, it is imperative to clean and format the data as well as remove erroneous or missing values. Furthermore, this chapter discusses descriptions of the independent and dependent variables for modeling considerations. Lastly, we provide the modeling techniques applied for analysis.

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IV. RESULTS AND ANALYSIS

This chapter presents the outcomes of the statistical models we discussed in the previous chapter.

A. MODEL 1 RESULTS

We perform cross-validation to interpret how effectively the current prerequisites model classifies observations outside the data. To validate the model, we randomly divide the data into a training set and test set. The training set excludes 25 percent of the population and contains 557 observations. The remaining 185 observations constitute the test set. We generate the variable *ygrad* from the prediction results of our model. According to Wooldridge (2016), "There are four possible outcomes on each pair, when both are zero or both are one, we make the correct prediction" (p. 530). In addition, we identify the number of observations our model predicts as false negatives and false positives. The sum of false positives and false negatives divided by the total number of observations determines the misclassification rate. A significant difference in the misclassification rate between the training set and test set suggest the model might be over fit. The training set generates 217 false negatives and 28 false positives for misclass rate of 44.06 percent. The test set predicts 37 false negatives and 46 false positives for a misclass rate of 44.86 percent. Table 10 displays the cross-validation results for Model 1.

Table 10. Model 1 Percent Correctly Predicted

Training Set				Test Set			
ygrad				ygrad			
GRAD	**0**	**1**	**Total**	**GRAD**	**0**	**1**	**Total**
1	217 39.03	32 5.58	249 44.60	**1**	37 20.00	61 32.97	98 52.97
0	280 50.36	28 5.04	308 55.40	**0**	41 22.16	46 24.86	87 47.03
Total	497 89.39	169 10.61	557 100.00	**Total**	78 42.16	46 24.86	185 100.00
Misclass Rate = 44.06%				Misclass Rate: 44.86%			

The current prerequisite model analyzes three performance variables and the dependent variable remains graduation. Table 11 presents the findings of our first model. The table lists the predictor variables, partial effects with their respective standard errors. An examination of the current attendance criteria yields one significant variable. The model determines general technical scores statistically significant at the 10 percent level with a marginal effects coefficient of .00311. Holding all else constant, a 10-point increase in GT score (μ=111.75) increases the probability of graduation by 3.1 percent.

Table 11. Model 1 Results

Variables	Partial Effects (dy/dx)	Standard Errors
GT	0.00311*	(0.0019)
Rifle Score	0.00128	(0.0012)
PFT Score	0.00179	(0.0014)
Observations	742	
R-Squared	0.0056	
Standard errors in parentheses		
*** p<0.01, ** p<0.05, * p<0.1		

B. MODEL 2 RESULTS

Model 2 explores a wider range of explanatory variables to calculate which observable traits increase the probability of graduation. The predicted variable remains graduation equal to "1" if the student completes the course. As previously discussed, a rank other than NCO and rifleman serves as the reference group. The results of this model discover 13 significant variables. Table 13 displays the coefficients and standard errors of each variable.

Table 12. Model 2 Percent Correctly Predicted

Training Set				Test Set			
ygrad				ygrad			
GRAD	**0**	**1**	**Total**	**GRAD**	**0**	**1**	**Total**
1	113 20.29	135 24.24	248 44.52	**1**	27 14.59	71 38.38	98 52.97
0	230 41.29	79 14.18	309 55.48	**0**	59 31.89	28 15.14	89 47.03
Total	343 61.58	214 38.42	557 100	**Total**	86 46.49	99 53.51	185 100
Misclass Rate = 34.47%				Misclass Rate: 29.73%			

We conduct a cross-validation of Model 2 in the same manner as the previous model. The training set for Model 2 predicts 113 false negatives and 79 false positives for a misclass rate of 34.47 percent. The test set for this model produces 27 false positives and 28 false negatives resulting in a misclass rate of 29.73 percent. Table 12 displays the cross-validation results.

Table 13. Model 2 Results

Variables	Marginal Effect (dy/dx)	Standard Errors
Nonwhite	0.0496	(0.0774)
Married	0.0529	(0.0462)
Age < 20	0.0377	(0.0712)
Age21- 23	**0.0941***	**(0.0553)**
Age24 -25	0.0852	(0.0590)
District8	**0.0983***	**(0.0561)**
District12	**0.0833***	**(0.0479)**
Some college	0.14	(0.1710)
Assoc. Degree	-0.0642	(0.1480)
College Degree	-0.00992	(0.1240)
CPL	-0.0164	(0.0480)
SGT	**-0.176****	**(0.0749)**
Recon Marine	**0.109***	**(0.0572)**
Machine Gunner	-0.0736	(0.0586)
Mortarman	-0.0201	(0.0792)
Assault Marine	-0.055	(0.0868)
Missile Marine	-0.0254	(0.1040)
Special Ops. Marine	-0.000628	(0.1050)
TIS < 2	**-0.159****	**(0.0631)**
TIS 5–6	-0.0124	(0.0845)
TIS 7–8	0.0368	(0.1080)
TIS 9–10	0.0562	(0.1610)
Prior Drop	**0.177*****	**(0.5560)**
Rifle Sharpshooter	**-0.105****	**(0.0493)**
Pistol Expert	0.04	(0.0578)
Pistol Marksman	-0.0961	(0.0775)
PFT <250	0.184	(0.1130)
PFT 250–284	**-0.0675***	**(0.0393)**
CFT Score	0.00552	(0.0040)
IST Pull-ups	**-0.00748****	**(0.0037)**
Pros < 4.4	**-0.186*****	**(0.0654)**
Pros >4.5	**0.163****	**(0.0695)**
Cons < 4.4	0.0397	(0.0704)
Cons > 4.5	**-0.117***	**(0.0682)**
AR	0.00568	(0.0036)
CL	0.00205	(0.0016)
GS	**-0.00756****	**(0.0035)**
AS	**0.00628****	**(0.0029)**
Observations	742	
R-Squared	0.0840	
Standard errors in parentheses		
*** p<0.01, ** p<0.05, * p<0.1		

1. Demographics

Model 2 reveals a student's age, home of record, rank, MOS, and time in service as significant graduation factors. The positive coefficient .094 for students between the ages of 21 and 23 (n=257) displays significance at the 10 percent level. Holding all else equal, this implies students in this age bracket have a 9.4 percent higher probability of completing the course than students over the age of 25.

Marine Corps Recruiting Districts 8 and 12 (n=290) exhibit significance at the 10 percent level with marginal coefficients of .098 and .083, respectively. On average, holding all else constant, students from District 8 and 12 may enjoy a higher probability of graduating the course by 9.8 and 8.3 percent. The rural settings and moderate temperatures in the Southwest and West Coast perhaps lead to participation in activities that develop fieldcraft and marksmanship, thereby enhancing performance at Scout Sniper Course.

The negative marginal coefficient .176 for the rank of Sergeant (n=127) holds significance at the five percent level. On average, all other things being equal, holding the rank of Sergeant potentially decreases the probability of graduation by 18 percent. Sergeants develop habits of action stemming from their experience as Infantry Marines; however, not all their practices transfer to developing new skillsets. Furthermore, the inability or unwillingness to deviate from established practices may decreases performance.

The MOS Reconnaissance Marine (n=138) demonstrates significance at the five percent level. The marginal effects coefficient .109 reveals Recon Marines likely have an 11 percent higher probability of completing the course. Completion of the Basic Reconnaissance Course (BRC) serves as a proxy for success at Scout Sniper Course. The overlap between the schools includes land navigation, patrolling, concealment exercises, and developing operational orders. Converting the complementary skills taught at BRC naturally leads to success at SSC.

In addition, we find time in service less than two years (n=90) significant at the five percent level. On average, a Marine with less than two years of service decreases the

probability of completing the course by 16 percent. Successfully negotiating the course appears to require gaining experience and maturity in the operational forces.

The positive marginal effects coefficient .177 for the variable Prior Drop (n=103) reports significance at the one percent level. On average, holding all else constant, a student removed from a previous course for academic failure possibly increases the probability of graduation at a future course by 18 percent. The invaluable experience and training gained from attending a previous course readily translates to prospering in a later course.

2. Performance

Model 2 identifies six significant performance variables to include rifle score, PFT score, IST pullups, and proficiency and conduct marks. The negative marginal effects coefficient .105 for the variable rifle sharpshooter (n=140) shows statistical significance at the five percent level. On average, holding all else constant, this coefficient indicates an 11 percent decrease in the probability of graduation compared to a rifle expert.

At the 10 percent level, the variable mid_pft (n=362) reveals statistical significance. The negative marginal effects coefficient .0675 disclosures students with a PFT score between 250 and 285 points could decrease their probability of graduation by 6.8 percent. The physical demands of the 12-week course require strength and endurance. Consequentially, students with average levels of physical fitness struggle compared to students with PFT scores greater than 285 points. By creating a quadratic variable for PFT score, we calculate a PFT score of 263 as the point the score becomes positive. However, the variable IST pull-ups reports significance at the five percent level with a negative coefficient. The marginal effects coefficient -.007, all else being equal, signals for every additional pull-up a recruit performs potentially decreases the probability of completing SSC by .75 percent. This finding indicates IST endurance (run time and crunches) supersede strength. This outcome further illuminates the importance of physical stamina while attending the course.

We observe proficiency marks below the sample population average, 4.4, as significant at the one percent level. Ceteris paribus, proficiency marks below the sample population average (n=184) decreases the probability of graduation by 19 percent. At the same time, we find proficiency marks higher than the average (n=234), statistically significant at the five percent level, increase the probability of graduation by 16 percent. Demonstrating mastery in their craft prior to attending the course naturally accompanies course achievement. Alternatively, conduct marks above the sample average (n=252), 4.4, negatively impact the probability of graduation. The marginal coefficient .117 suggests, on average, an increase in conduct marks decreases the probability of graduation by 12 percent. Our research speculates that serving as a Scout Sniper requires individuals who are nonconformist and capable of deviating from the norms of conventional warfare to perform their duties.

3. ASVAB Scores

Our research finds the ASVAB subtest for auto shop (μ=52.89) significant at the five percent level. The positive marginal coefficient .00628 implies, on average, all else constant, a 10-point increase in score increases the probability of graduation by 6.3 percent. Students more familiar with tools and their application likely perform scope and optic adjustments quicker after engaging targets. This allows them to allocate more time to prepare for following engagements. On the other hand, general science (μ=56.05) negatively impacts the probability of graduation. Every additional point a recruit scores on this subtest reduces the probability of graduation by .76 percent.

C. MODEL 3

Model 3 uses the significant course prerequisites as controls and includes the non-cognitive traits "grit," extraversion, conscientiousness, and neuroticism. In addition, the model incorporates rank and MOS as additional controls. Table 14 contains the variables, coefficients, and standard errors.

Table 14. Model 3 Results

Variables	Marginal Effects (dy/dx)	Standard Errors
Rifle Score	0.00692	(0.0101)
PFT Score	-0.000308	(0.0053)
GT	0.00645	(0.0075)
Grit	0.602*	(0.3270)
Extraversion	-0.0341**	(0.0169)
Conscientiousness	-0.0393*	(0.0212)
Neuroticism	-0.0451**	(0.0189)
CPL	0.157	(0.1610)
Rifleman	0.207	(0.1560)
Observations	48	
R-Squared	.2511	
Standard errors in parentheses		
*** p<0.01, ** p<0.05, * p<0.1		

In order to determine the misclassification rate for this model we develop the binary variable *ygrad* defined as "1" if the predicted probability of graduation is at least 40 percent and "0" if otherwise. We also generate the binary variable *xgrad* defined as "1" if the predicted probability of graduation is at least 75 percent and "0" if otherwise. These variables allow us to identify the number of false negatives and false positives this model produces. The 40 percent probability of graduation threshold results in a misclassification rate of 33.33 percent with 4 false negatives and 12 false positives. Increasing the probability of graduation threshold reduces the misclassification rate. The higher threshold results in 13 false negatives and 1 false positive for a misclass rate of 29.16 percent. Table 14 displays the goodness-of-fit for Model 3.

Table 15. Model 3 Percent Correctly Predicted

Probability of Graduation 40%				Probability of Graduation 75%			
Most Likely Grad				Most Likely Grad			
GRAD	**0**	**1**	**Total**	**GRAD**	**0**	**1**	**Total**
1	4 50.00	28 70.00	32 66.67	**1**	13 46.43	19 95.00	32 66.67
0	4 50.00	12 30.00	16 33.33	**0**	15 53.57	1 5.00	16 33.33
Total	8 100	40 100	48 100	**Total**	28 100	20 100	48 100
Misclass Rate = 33.33%				Misclass Rate: 29.16%			

1. Grit

The positive marginal coefficient .602 exhibits significance at the 10 percent level. On average, holding all else constant, a .1 increase in "grit" score improves the probability of graduation by 60 percent. The Scatterplot matrix in Figure 2 displays the positive relationship between grit scores and the probability of graduation. The red line indicates the historic graduation rate of 45 percent. Students with a Grit score of 4.2 or higher increase their probability of graduating.

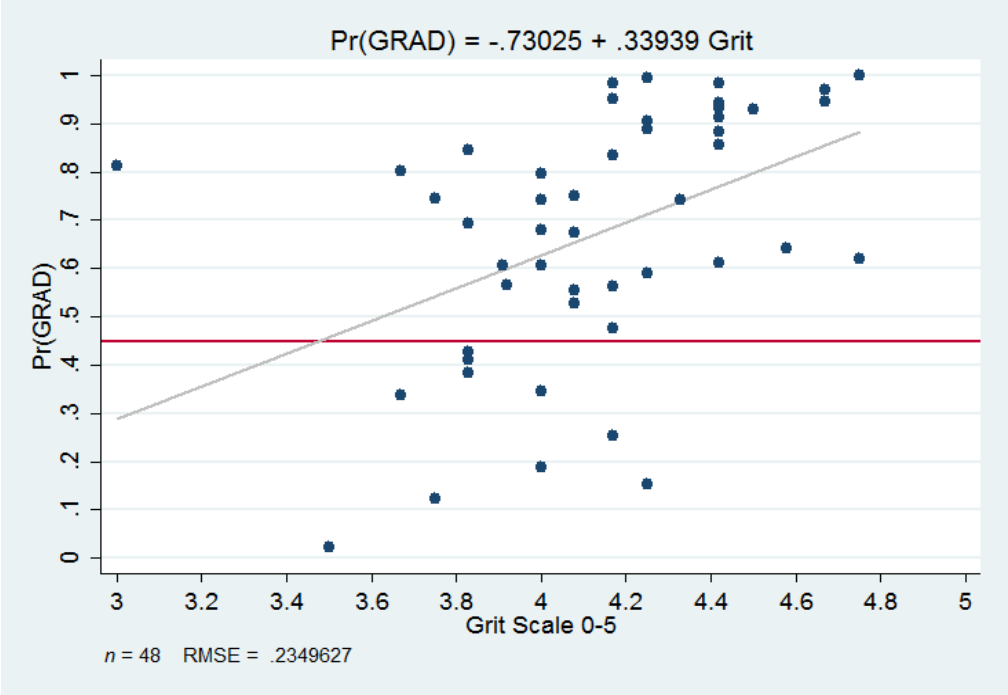

Figure 2. Scatterplot of Grit and Probability of Success

On average, graduating students score 4.2 on the Grit Scale. Students failing to complete the course score 4.0. The box plot in Figure 3 presents Grit scores by outcome. The scores on the right reflect student inputs for those who successfully completed the course. Graduating students Grit scores cluster around 4.2 where the majority of student failing to complete the course report Grit scores of 4.0.

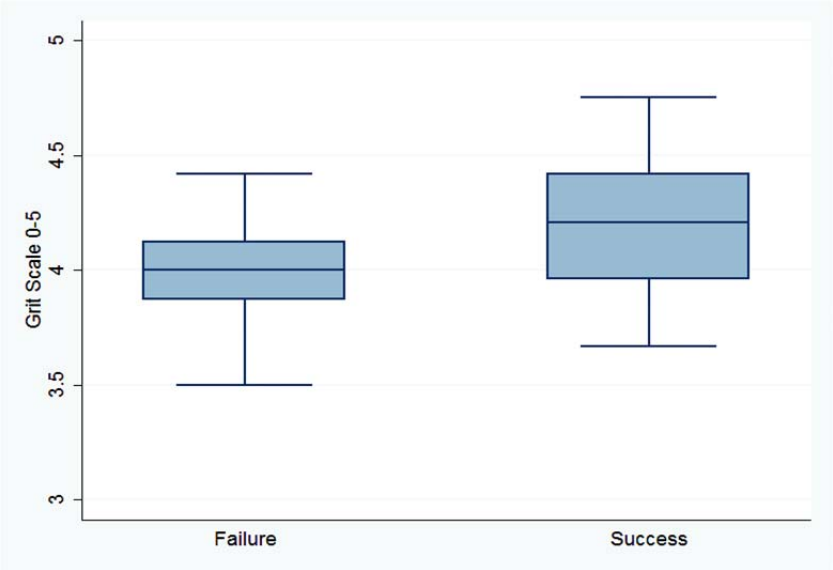

Figure 3. Grit Scores by Outcome

Further analysis of this variable reveals rank, and MOS contribute to higher levels of "grit." In order to identify grittier individuals, we explore observable traits and their relationship with "grit." Figure 4 reveals Sergeants (μ=4.21) and Staff Sergeants (μ=4.42) possess higher levels of "grit." Undoubtedly, achieving the ranks of Sergeant and Staff Sergeant requires perseverance. Furthermore, the time in service requirements to achieve these ranks in the infantry indicate a higher level of commitment.

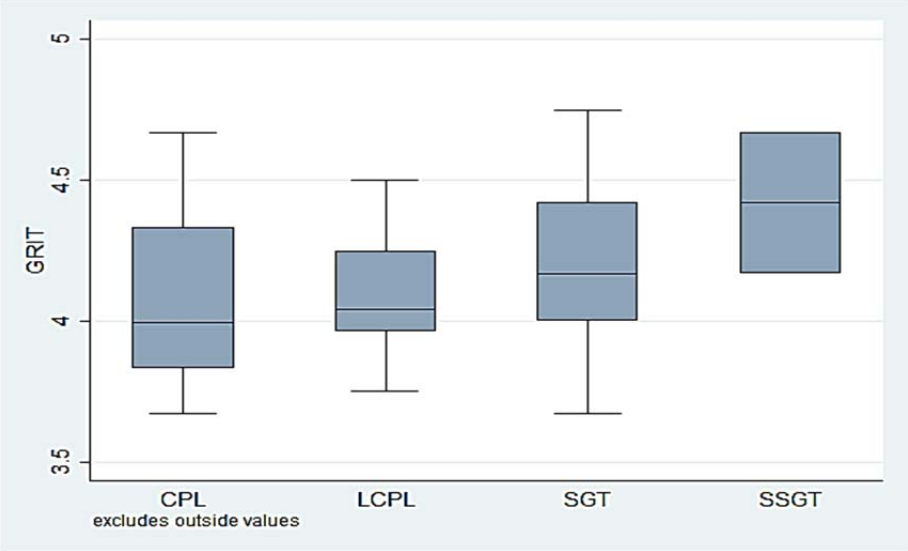

Figure 4. Grit by Rank

In addition, we analyze the connection between "grit" and MOS. Figure 5 discloses students holding the MOS Infantry Unit Leader score high on the Grit Scale (μ=4.23). The result of years of service and holding the rank Staff Sergeant heightens "grit" levels. Riflemen also average higher Grit scores (μ=4.15) relative to Marines in crew served weapons MOSs (μ=3.94). The maneuver element during offensive operations consists largely of riflemen bounding toward the objective under the weight of a combat load. Meanwhile crew served weapons MOSs typically remain stationary. The determination required to execute such training might develop elevated levels of "grit" in riflemen.

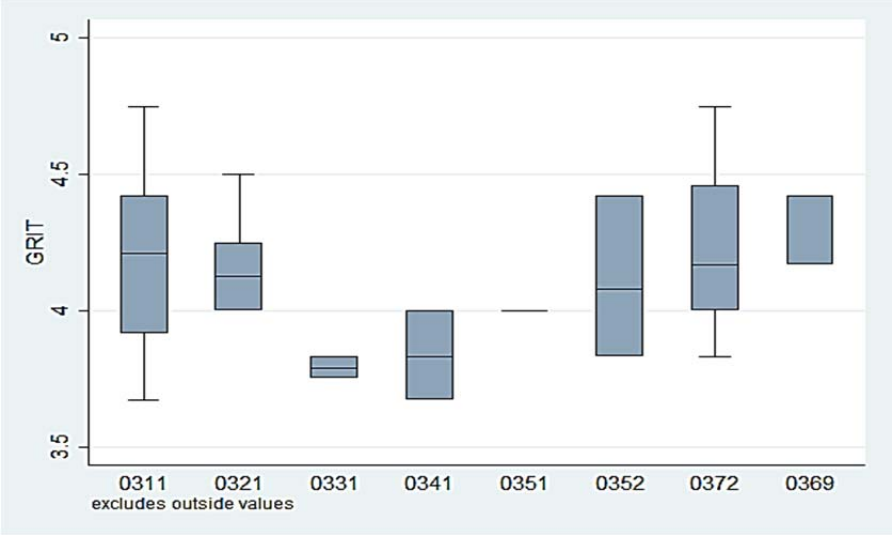

Figure 5. Grit by MOS

2. Big Five Traits

The negative coefficients for extraversion, conscientiousness, and neuroticism indicate higher scores on these elements of the Big Five questionnaire decrease the probability of graduation. The traits agreeableness and openness did not yield significant results.

The negative marginal coefficient .0341 for extraversion (μ=27.29) indicates statistical significance at the five percent level. All else being equal, on average, a one point increase in extraversion decreases the probability of graduation by 3.4 percent. Higher extraversion scores indicate an individual's level of assertiveness. Individuals displaying too much assertiveness can damage relationships and lower team assessments (Sauer, 2011, p. 576). Students displaying overwhelming levels of extraversion decrease team efficiency leading to course failure.

The missions Scout Snipers execute require teamwork and levelheadedness. The negative marginal coefficient .045 regarding neuroticism (μ=17.58) suggests a one point increase reduces the probability of graduation by 4.5 percent. In addition, Morgeson, Reider, and Campion (2005) report, "individuals low in emotional stability are less likely to be cooperative and will tend to have lower quality interactions with others in the work setting" (p. 589). Neuroticism scores show a student's emotional stability; therefore,

students registering elevated levels of neuroticism decrease their probability of course completion. Figure 6 displays the difference between course outcomes and neuroticism scores. On average, students reporting higher levels of neuroticism fail the course.

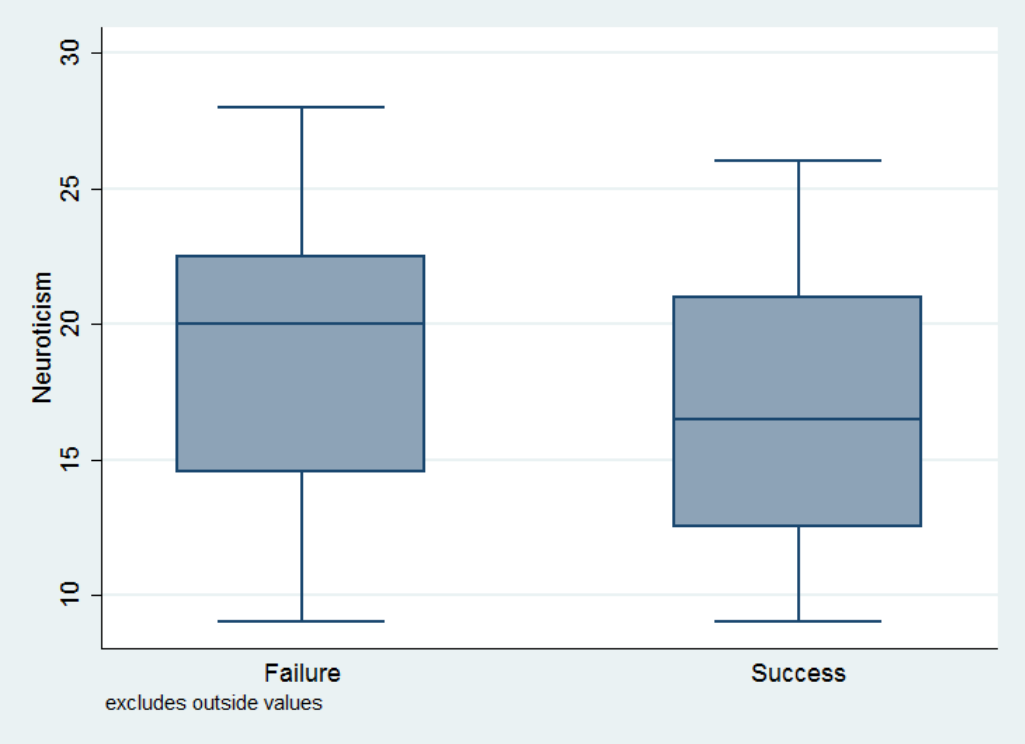

Figure 6. Neuroticism Scores by Outcome

The coefficient -.039 for conscientiousness (μ=38.38) implies, all else being equal, a point increase lowers the probability of completing the course by 3.9 percent. Factors contributing to the negative coefficient of conscientiousness likely stem from similar reasons associated with higher conduct marks decreasing the probability of graduation. Tett (1998) discovers a negative relationship between conscientiousness and job performance for police officers and sales managers. Tett (1998) contends, "The time it takes to go from an acceptable decision to a superb one may not be worth the added time when other fires are close to burning out of control" (para 4). Similar to the police officers in Tett's study, Scout Snipers engaging a target rarely possess perfect information or an abundance of time when making decisions. Tett (1998) also suggests

individuals with higher levels of conscientiousness adhere to rules, and strict observance of rules reduces innovation. In order to master concealment and remain undetected, Scout Snipers require ingenuity and imagination.

D. CHAPTER SUMMARY

This chapter presents the outcomes of the three probit models developed in order to identify the observable and non-cognitive traits that best predict success at Scout Sniper Course. Model 1 examines the course prerequisites and recognizes GT score as significant. Model 2 incorporates demographics, performance, and ASVAB components as explanatory variables. The results of Model 2 catalogs fifteen noteworthy variables. Lastly, Model 3 integrates non-cognitive attributes to forecast success. Holding constant the current course attendance criteria, four non-cognitive traits exhibit significance.

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V. CONCLUSION AND RECOMMENDATIONS

A. CONCLUSIONS

This thesis employs multivariate probit models to investigate which observable traits best predict success at USMC Scout Sniper Course. In addition, we incorporate noncognitive testing to identify which personality traits might increase the probability of graduation. We find evidence that suggests incorporating noncognitive testing during the screening process may reduce the attrition rate at Scout Sniper Course. This chapter outlines the discoveries and recommendations we extract from the probit models employed for this research.

B. WHAT SCOUT SNIPER COURSE PRE-REQUISITES OUGHT TO CHANGE AS A RESULT OF THIS RESEARCH?

1. Conclusion

Our analysis of the current course pre-requisites reports one statistically significant predictor variable. We find that an expert rifle qualification and first class PFT are not statistically significant. However, we discover higher GT scores might increase the probability of completing the course. GT scores display statistical significance at the 10 percent level. A one point increase in GT score could increase the probability of graduation by 3.1 percent.

2. Recommendation

The Marine Corps allows Marines from every MOS to join reconnaissance and special operations units. Therefore, we recommend Scout Sniper Course expand the attendance criteria and provide Marines from all MOSs the opportunity to attend the course. By opening the course to all occupational fields and assigning lateral transfers to infantry battalions, the Marine Corps could reduce the shortfalls in Scout Sniper platoons. We further recommend students from non-infantry MOSs meet the current course pre-requisites and hold a rank between Private and Corporal.

C. WHAT ARE THE MOST INFLUENTIAL INDEPENDENT VARIABLES THAT PREDICT SUCCESS AT U.S. MARINE CORPS SCOUT SNIPER COURSE?

1. Conclusion

As shown in Table 13, Model 2 identifies seven positive and eight negative predictor variables that aid in answering this question. Positive factors associated with graduation include: Attending a previous course, Reconnaissance Marine, above average proficiency marks, students between the ages of 21 and 23, students from MCRC districts 8 and 12, and ASVAB subtest scores for Auto Shop. The variable capturing students that attended a previous course displays significance at the one percent level. Above average proficiency marks and Auto Shop scores exhibit significance at the five percent level. The model finds the variable representing Recon Marine, ages 21–23, and students from districts 8 and 12 shows statistical significance at the one percent level.

Predictor variables with negative and significant coefficients include: Sergeant, time in service less two years, rifle sharpshooter, average PFT, count of IST pull-ups, below average proficiency marks, above average conduct marks, and General Science scores. These variables demonstrate significance at the five and ten percent level.

2. Recommendation

We recommend units screening Marines expand the aperture through which they evaluate candidates and consider time in service, rank, age, and average proficiency and conduct marks. In addition, we recommend all potential students attend a preliminary course prior to receiving orders to a MOS producing school. The development of regimental Scout Sniper courses that closely mirror each division's Scout Sniper Course will likely decrease the attrition rate. Furthermore, mandatory attendance allows units to continue the vetting process prior to assigning Marines for duty as a Scout Sniper.

D. WHAT NON-COGNITIVE TRAITS CAN BE LEVERAGED TO PREDICT SUCCESS SCOUT SNIPER COURSE AND PERFORMANCE AS A SCOUT SNIPER?

1. Conclusion

When we couple noncognitive traits with the current course pre-requisites, four individual characteristics display significance. The results from the Grit Scale inputs yield positive and significant results at the ten percent level. However, the Big Five traits of extraversion, conscientiousness, and neuroticism exhibit negative and significant behavior.

2. Recommendation

We recommend Scout Sniper Courses continue noncognitive testing in order to gather more observations. The limited variation among observable traits suggests success at Scout Sniper Course depends on intangible characteristics. Leveraging noncognitive test scores provides the USMC with insight into whether an individual possesses the right demeanor and temperament to serve as a Scout Sniper in the operational forces.

E. FURTHER RESEARCH

Our research concentrates solely on the Scout Sniper MOS. Based on the results of our research, we recommend future research expand this area of study to include a larger population in the Marine Corps. The development of standardized noncognitive measures could be further established to facilitate job matching across the Marine Corps.

Gathering noncognitive data from student officers arriving at The Basic School allows future research to determine which personalities tend to self-select into certain occupations. In addition, investigating student noncognitive inputs could provide insight into which personality traits translate to success as a Marine.

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APPENDIX A. GRIT SCALE

Adapted from Duckworth, A.L., Peterson, C., Matthews, M.D., & Kelly, D.R. (2007). Grit: Perseverance and passion for long-term goals. Journal of Personality and Social Psychology, 9, 1087–1101.

Here are a number of statements that may or may not apply to you. For the most accurate score, when responding, think of how you compare to most people -- not just the people you know well, but most people in the world. There are no right or wrong answers, so just answer honestly!

I have overcome setbacks to conquer an important challenge.
- Very much like me
- Mostly like me
- Somewhat like me
- Not much like me
- Not like me at all

New ideas and projects sometimes distract me from previous ones.
- Very much like me
- Mostly like me
- Somewhat like me
- Not much like me
- Not like me at all

My interests change from year to year.
- Very much like me
- Mostly like me
- Somewhat like me
- Not much like me
- Not like me at all

Setbacks don't discourage me.
- Very much like me
- Mostly like me
- Somewhat like me
- Not much like me
- Not like me at all

I have been obsessed with a certain idea or project for a short time but later lost interest.

Very much like me
Mostly like me
Somewhat like me
Not much like me
Not like me at all

I am a hard worker.

Very much like me
Mostly like me
Somewhat like me
Not much like me
Not like me at all

I often set a goal but later choose to pursue a different one.

Very much like me
Mostly like me
Somewhat like me
Not much like me
Not like me at all

I have difficulty maintaining my focus on projects that take more than a few months to complete.

Very much like me
Mostly like me
Somewhat like me
Not much like me
Not like me at all

I finish whatever I begin.

Very much like me
Mostly like me
Somewhat like me
Not much like me
Not like me at all

I have achieved a goal that took years of work.

Very much like me
Mostly like me
Somewhat like me
Not much like me
Not like me at all

I become interested in new pursuits every few months.

Very much like me
Mostly like me
Somewhat like me
Not much like me
Not like me at all

I am diligent.

Very much like me
Mostly like me
Somewhat like me
Not much like me
Not like me at all

Scoring:

1. For questions 1, 4, 6, 9, 10 and 12 assign the following points: 5 = Very much like me 4 = Mostly like me 3 = Somewhat like me 2 = Not much like me 1 = Not like me at all

2. For questions 2, 3, 5, 7, 8 and 11 assign the following points: 1 = Very much like me 2 = Mostly like me 3 = Somewhat like me 4 = Not much like me 5 = Not like me at all

Add up all the points and divide by 12. The maximum score on this scale is 5 (extremely gritty), and the lowest scale on this scale is 1 (not at all gritty).

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APPENDIX B. BIG FIVE QUESTIONNAIRE

Adapted from: John, O. & Srivastava, S. (1999). The Big Five trait taxonomy. Retrieved from http://www.fetzer.org/sites/default/files/images/stories/pdf/.../Personality-BigFiveInventory.pdf

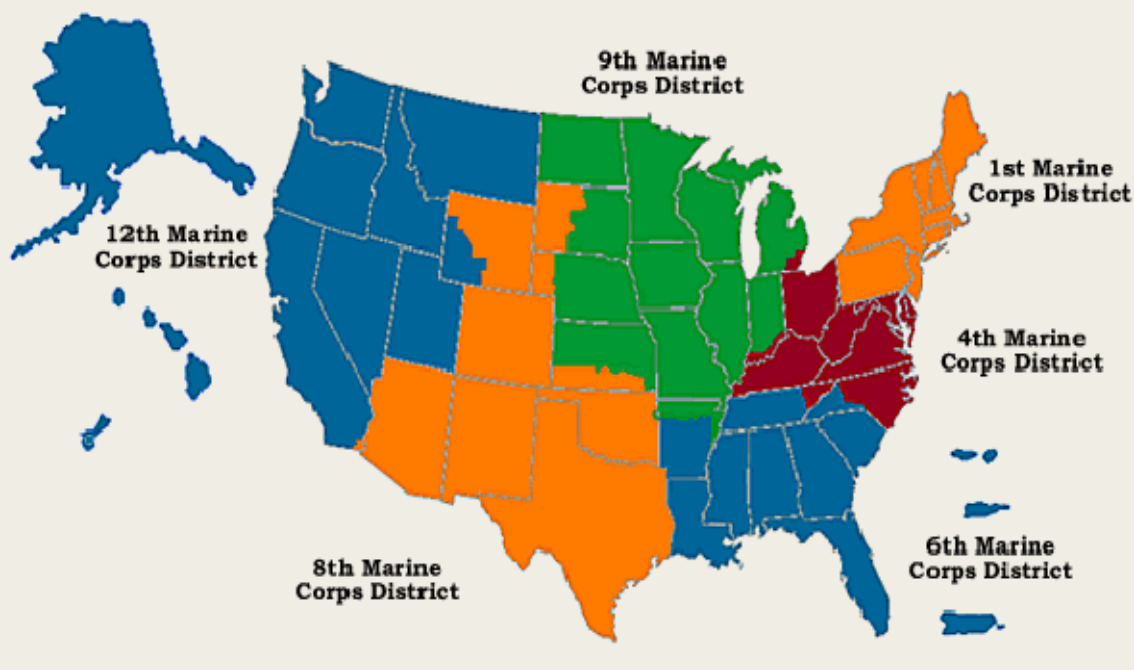
Disagree Strongly 1	Disagree a little 2	Neither agree nor disagree 3	Agree a little 4	Agree Strongly 5

Rating	I see myself as someone who is…..	Rating	I see myself as someone who is…..
	1. Is talkative		23. Tends to be lazy
	2. Tends to find fault with others		24. Is emotionally stable, not easily upset
	3. Does a thorough job		25. Is inventive
	4. Is depressed, blue		26. Has an assertive personality
	5. Is original, comes up with new ideas		27. Can be cold and aloof
	6. Is reserved		28. Perseveres until the task is finished
	7. Is helpful and unselfish with others		29. Can be moody
	8. Can be somewhat careless		30. Values artistic, aesthetic experiences
	9. Is relaxed, handles stress well		31. Is sometimes shy, inhibited
	10. Is curious about many different things		32. Is considerate and kind to almost everyone
	11. Is full of energy		33. Does things efficiently
	12. Starts quarrels with others		34. Remains calm in tense situations
	13. Is a reliable worker		35. Prefers work that is routine
	14. Can be tense		36. Is outgoing, sociable
	15. Is ingenious, a deep thinker		37. Is sometimes rude to others
	16. Generates a lot of enthusiasm		38. Makes plans and follows through with them
	17. Has a forgiving nature		39. Gets nervous easily
	18. Tends to be disorganized		40. Likes to reflect, play with ideas
	19. Worries a lot		41. Has few artistic interests
	20. Has an active imagination		42. Likes to cooperate with others
	21. Tends to be quiet		43. Is easily distracted
	22. Is generally trusting		44. Is sophisticated in art, or music

Scoring:

BFI scale scoring ("R" denotes reverse-scored items):
Extraversion: 1, 6R, 11, 16, 21R, 26, 31R, 36
Agreeableness: 2R, 7, 12R, 17, 22, 27R, 32, 37R, 42
Conscientiousness: 3, 8R, 13, 18R, 23R, 28, 33, 38, 43R
Neuroticism: 4, 9R, 14, 19, 24R, 29, 34R, 39
Openness: 5, 10, 15, 20, 25, 30, 35R, 40, 41R, 44

APPENDIX C. MARINE CORPS RECRUITING DISTRICTS



Retrieved from http://marinecorpsrecruit.com/usmc-recruiter/usmc-recruiting-districts-map/

Figure 7. Marine Corps Recruiting Districts. Adapted from USMC (2017).

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